STATUS OF MINERAL RESOURCE INFORMATION FOR THE ACOMA INDIAN RESERVATION, NEW MEXICO

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SUMMARY AND CONCLUSIONS

Commercial production of mineral resources on the Acoma Indian Reservation has been limited to sand and gravel. Clay is mined by the Indians and used for pottery making, and jet, a form of coal, is collected, polished, and used by Indian silversmiths for settings in jewelry. Rock is quarried and used by tribal members to build homes and other buildings on the reservation. These uses for Indian owned resources will continue and possibly may expand slightly in the future.

Moderate coal resources may exist on the reservation, but the development potential cannot be adequately assessed prior to a detailed field examination. Field work is necessary to: (1) determine the quantity of coal present, (2) locate minable deposits, both strip and underground, (3) obtain samples and ascertain coal quality, and (4) determine if a market exists in the region that would sustain a large mining operation. Uranium of sub-ore grade was discovered on Indian land in 1955, and the deposit might contain ore-grade material because of today's high uranium price. It might be possible to recover the uranium by recently developed in-situ leaching methods.

INTRODUCTION

This report was prepared for the U. S. Bureau of Indian Affairs by the U. S. Geological Survey and the U. S. Bureau of Mines under an agreement to compile and summarize available information on the geology, mineral resources, and potential for mineral development on certain Indian lands. Source material consisted of published and unpublished reports, and personal communication. There was no field work.

The Acoma Indian Reservation is wholly within Valencia County in northwestern New Mexico (Figure 1), and is an irregular-shaped area of 245,672 acres (99,497 ha), of which 320 acres (129 ha) consists of allotted lands and 6 acres is held by non-Indians. The tribe also owns five sections of land north of the main reservation area in T. 11 N., Rs. 8 and 9 W.

The reservation, located on the southern margin of the San Juan Basin, is an area of mesas, intervening flat valleys, and spectacular scenery. Interstate Highway 40 paralleled by tracks of the Santa Fe Railway Co. passes through the extreme northern part of the reservation. State and Bureau of Indian Affairs roads provide access to southern and central parts of the area.

Principal towns of the area are Albuquerque (population 243,751), about 60 miles (80.45 km) east, and Grants (population 11,500) about 8 miles northwest of the reservation. The population of Acomita, the main village on the reservation, in 1960, was about 500 (Rand McNally Road Atlas).

MINERAL OWNERSHIP

The Acoma Tribe owns the minerals on most of its land, but in some areas, particularly in the southern part of the reservation, all or some of the minerals are held by others. Table 1 lists areas in which the minerals are not owned by the Indians.

TABLE 1

Areas on the Acoma Reservation in Which the Acoma Tribe Does Not Own Mineral Rights

Owner	Location			Minerals Owned
	Section	Township	Range	
New Mexico Arizona Land Co.	Odd	6 N	8 W	Oil and gas
Do	Odd	6 N	9 W	Do
Do	1	6 N	10 W	Do
Do	3	6 N	10 W	Do
Do	9	6 N	10 W	Do
Do	11	6 N	10 W	Do
Do	13	6 N	10 W	Do
Do	25	6 N	10 W	Do
Do	27	6 N	10 W	Do
Do	35	6 N	10 W	Do
Do	Odd	7 N	7 W	Do
Do	Odd	7 N	8 W	Do
Do	13	7 N	9 W	Do
Do	23	7 N	9 W	Do
Do	25	7 N	9 W	Do
Do	27	8 N	8 W	Do
Do	35	8 N	8 W	Do
Do	S½ 25	8 N	8 W	Do
Do	S½ 27	8 N	8 W	Do
Do	S½ 29	8 N	8 W	Do
Do	31	8 N	8 W	Do
Do	33	8 N	8 W	Do
Do	35	8 N	8 W	Do
Do	Odd	8 N	9 W	Do
State of Mexico	32, 36	8 N	8 W	All
Unknown	2	6 N	8 W	Surface minerals
Do	16	6 N	8 W	Do
Do	32	6 N	8 W	Do
Do	36	6 N	8 W	Do
Do	W½NW¼ 28	6 N	8 W	Do
Do	W½SW¼ 28	6 N	8 W	Do
Do	2	8 N	9 W	All
Do	16	8 N	9 W	Do
Do	32	8 N	9 W	Do
Do	36	8 N	9 W	Do
Do	E½NE¼ 13	8 N	10 W	Oil and gas
U.S. Government	N½ 10	8 N	9 W	All

GEOLOGY

General

The only recent geologic publications of areas within the Acoma reservation are geologic quadrangle maps by Thaden and others (1967), Maxwell (1976) and an open-file map by Knox (1967). Moench (1963a,b, 1964) mapped adjacent areas on the east, and Moench and Schlee (1967) include some discussion pertinent to the Acoma reservation. Geologic maps covering the northern and eastern part of the reservation are in preparation.

The exposed rocks in the region are mostly sandstone and shale with lesser amounts of limestone and coal capped in the southwestern part of the reservation by basaltic lava flows. The sedimentary rocks range in age from about 200 m.y. (million years) to 1 m.y., and are covered over much of the area by surficial material that ranges in age from about 1 m.y. to today's sand and silt. The lava flows are all comparatively recent. The oldest are less than 3 m.y.; samples from Mesa Chivato about 15 miles northwest of the reservation have been dated as 2.6 m.y. (Weber, 1971); the flows in the valley near McCartys are associated with artifacts that indicate an age of less than 1,100 years.

The sedimentary rocks are generally flat lying, but dip gently northwest in part of the area. West of McCartys, in the northwestern corner of the reservation, the rocks dip gently east and southeast.

Sedimentary Rock Units

The distribution of the rock units on the Acoma Reservation and surrounding areas is shown on Figure 2; Table 2 summarizes the stratigraphic sequence and thickness of the rock units. Figure 3 diagrammatically represents the complex intertonguing of the Cretaceous rocks in the region.

TABLE 2

Stratigraphic Sequence of Sedimentary Rock Units

Symbols on figure 2	Symbols on figure 3		Approximate Thickness Feet	Approximate Thickness Metres
		CRETACEOUS		
	Kmv	Mesaverde Group	120	40
	Kpl	Point Lookout Sandstone		
		Crevasse Canyon Formation		
	Kcg	Gibson Coal Member	300	100
	Kcd	Dalton Sandstone Member	120	40
	Km	Mancos Shale		
	Kmm	Mulatto Tongue	250-320	80-100
Kmv		Crevasse Canyon Formation		
	Kcs	Stray Sandstone	20-40	7-13
	Kcdi	Dilco Coal Member	160-180	55-60
	Kg	Gallup Sandstone	50-80	17-27
	Km	Mancos? Shale	100-120	35-40
Kg	Kg	Gallup Sandstone	20-40	7-13
	Km	Mancos? Shale	25-60	8-20
	Kg	Gallup Sandstone	20-30	6-10
	Km	Mancos Shale (main body)	300-350	100-117
	Kd	Dakota Sandstone		
	Kdt	Twowells Sandstone Tongue	0-80	0-27
Kdm	Kmw	Mancos Shale Whitewater Arroyo Tongue	70-140	23-47
	Kdp	Dakota Sandstone, Paguate Tongue	0-50	0-17
	Kmc	Mancos Shale, Clay Mesa Tongue	40-60	13-20
	Kdo	Oak Canyon Member	60-90	20-30
	Kds	basal sandstone units	0-60	0-20
		JURASSIC		
Jm	Jm	Morrison Formation	0-300	0-100
	Jz	Zuni Sandstone	10-300	3-100
	Jb	Bluff Sandstone	150-220	50-70
Ju		Jurassic undivided		
	Js	Summerville Formation	60-150	20-50
	Jtg	Gypsum beds	0-100	0-30
	Jt	Todilto Limestone	0-10	0-3
	Je	Entrada Sandstone	0-300	0-100
		TRIASSIC		
Tru		Triassic rocks undivided	300	100
	Trwr	Wingate Sandstone, Rock Point Member	300	100
	Trc	Chinle Shale	1,000	340

Triassic Rocks

Chinle Formation.--The Chinle Formation is the oldest outcropping sedimentary rock in the area. The Chinle is about 600 feet (200 m) thick in the southeastern part of the reservation; and is variegated red, purple, and gray shale with lenses of mudstone, sandstone, and conglomerate. It is soft and easily eroded and commonly is obscured by landslides; outcrops form a characteristic bedlands topography.

Wingate Sandstone.--The Rock Point Member of the Wingate Sandstone crops out on the mesa slope in the southwestern corner of the reservation. Only a thin wedge is exposed on the reservation but immediately to the south it thickens to about 250 feet (80 m) of light reddish-brown shaly siltstone and silty sandstone and white fine-grained sandstone.

Jurassic Rocks

Entrada Sandstone.--The Entrada Sandstone is composed of a lower light orangish red sandstone member, variable in thickness; a medial silty member, dark red-brown; and an upper eolian crossbedded sandstone, red-brown in the northern part of the area changing to light greenish white toward the southwest. The upper member forms the bold vertical and rounded cliffs along the base of the mesa in the southeastern part of the reservation.

Todilto Limestone.--The Todilto Limestone is a few feet thick east of Acoma Pueblo and pinches out about 3 miles to the south. It is dark gray thin-bedded to laminated, fetid, petroliferous, silty limestone, and is the host rock for several uranium occurrences east of the Acoma reservation.

Summerville Formation.--The Summerville Formation is siltstone and very fine grained sandstone, red-brown, pink and tan in the northern exposures, changing to light tan and white toward the south.

Bluff and Zuni Sandstones.--The Bluff and Zuni Sandstones are generally mapped together as one unit in the region. The Bluff is a fluviatile sandstone, reddish brown north and east of the reservation, changing to light brown and tan to the west and south. It is thickest in the north, thinning and merging with the Zuni to the south. The Zuni is a light-brown to tan eolian sandstone, thin but variable in thickness in the northern part and thickening to 300 feet or more to the south. The Bluff outcrop is a conspicuous vertical cliff in most exposures, and the Zuni crops out as smoothly rounded steep slopes above the cliff in the northern part of the reservation. To the southwest the two units merge and form spectacular vertical cliffs - several hundred feet high. Acoma Pueblo, Sky City, is at the top of near-vertical cliffs of Bluff and Zuni Sandstone, that extend about 200 feet above the valley floor.

Morrison Formation.--The Morrison Formation is the most important unit in the region, because it is the host rock for all of the important uranium deposits. The Morrison is truncated along an east-west line across the central part of the reservation

by the erosional unconformity at the base of the Dakota Sandstone, which southward cuts down across all of the Jurassic and some of the Triassic rocks.

The Morrison Formation has been divided into four members (Moench and Schlee, 1967). The basal unit is the Recapture Member, followed by the Westwater Canyon Member, the Brush Basin Member, and the Jackpile Sandstone. The Recapture is a grayish red and brownish red sandstone with some interstratified mudstone at the top. It varies from 10 to more than 50 feet thick and is absent locally. It is classified in part as a fossil soil zone (Maxwell, 1976). The next overlying unit is a conglomerate composed of fragments and pebbles, both angular and rounded, of quartz, chert, igneous rocks, pegmatite, quartzite, limestone, siltstone, clay balls, and dinosaur bones, in a matrix of sand, silt, and clay. This conglomerate together with an overlying lenticular sandstone and conglomerate is mapped as the Westwater Canyon Member, and varies from 0 to more than 30 feet thick. It is the major host for the uranium deposits in the Grants-Gallup area. Almost all of the Morrison Formation in the Acoma area is Brushy Basin Member, a green and grayish green mudstone and shale with lenses of sandstone and limestone. The Jackpile Sandstone overlies and locally intertongues with the Brushy Basin. It is a sandstone similar to the Westwater and is the host rock for most of the uranium deposits in the Laguna area, northeast of the Acoma reservation. The distal edge of the Jackpile is exposed near the town of Seama (Figure 2).

Cretaceous Rocks

The Cretaceous rocks in the region comprise a complexly intertongued sequence of marine and continental sediments. Figure 3 diagrammatically represents the intertonguing of the continental Dakota Sandstone and Mesaverde Group with the marine Mancos Shale.

Dakota Sandstone.--In most the Acoma Reservation area the Dakota Sandstone formed from marginal marine and shoreline sedimentation; it becomes progressively more continental toward the south and west. The Dakota is composed of conglomerate and sandstone at the base and is overlain by siltstone with thin shale layers and sandstone lenses, and of sandstone and siltstone tongues interlayered with the Mancos Shale.

Mancos Shale.--The Mancos Shale is dark gray clay and silt shale which weathers to broad flat areas, smooth slopes, and badlands topography, and is locally covered by landslides. It is gradational in some cases into gray-brown siltstone and into intertonguing sandstone.

Mesaverde Group.--The Mesaverde Group is divided into three formations, the Point Lookout Sandstone, the Crevasse Canyon Formation, and the Gallup Sandstone. The group is composed mostly of continental sandstone and siltstone with minor marginal marine siltstone and shale. The only units of potential economic interest in the Acoma area are the Dilco Coal Member and the Gibson Coal Member of the Crevasse Canyon Formation.

The Dilco Coal Member is thin-bedded to lamellar sandstone, siltstone, and shale with numerous interbeds of highly carbonaceous shale and coal, most of which are only a few centimeters thick; the thickest coal bed in outcrop is about 50 cm.

The Gibson Coal Member is present in the northern part of Cebolleta Mesa and on Mesa Negra, beneath slopes covered by landslides and talus. Colluvial material containing chips of very carbonaceous shale and black powdery coalified material is common locally. The Gibson has no coal beds of current commercial importance, but it does have a potential about equal to that of the Dilco.

Tertiary and Quaternary Rocks

Gravel Beds.--The gravel beds shown on the geologic map (Tg) are apparently late Tertiary and early Quaternary in age. The cemented beds at higher elevations are probably correlative with the Santa Fe Formation; the ones at lower elevations in the valleys are probably related to early stages in the erosional development of the present topography. The gravel beds near San Fidel have been used as a source of aggregate and road metal, and the ones near Acomita and 10 miles south of McCartys constitute the only remaining reserves on the reservation.

Landslides.--Landslides are a conspicuous feature of the Acoma reservation. The largest or more conspicuous are shown on the geologic map (Figure 2), others occur on almost every hill and mesa in the region where Chinle shale, Morrison Formation, or Mancos Shale are capped by sandstone beds or basalt flows. They are more common and larger on the north and west facing slopes, than on the south facing slopes. The landslides, generally in the form of toreva blocks (Reiche, 1937) were formed during an early wet period, probably late Pleistocene, followed by progressive changes in climate to the present arid conditions. During the wet period large amounts of water percolated through porous sandstones and basalt, soaked and weakened the underlying shales, and produced numerous landslides. As the volume of precipitation lessened, landslides occurred less frequently and less alluvial material was carried away. Eventually the slides stabilized and the valleys were choked with alluvium which covered many of the lower slides and filled the valleys to form broad flat floors. Flash flooding characteristic of the present arid conditions has produced deep gullies in the alluvium, exhuming some landslide blocks.

Alluvium.--Alluvium, colluvium, and recent wind blown sand cover large areas in the region, and are as much as 100 feet thick in some areas. Only the largest and thickest deposits are shown on the geologic map.

Igneous Rocks

Mafic Intrusives

Diabase dikes and sills generally only a few inches to 1 or 2 feet thick but locally 10 feet or more thick, are common in much of the area. One dike, near Acoma Pueblo and McCartys, has been traced for more than 18 miles. It was quarried near

its juncture with the Crow Point fault and crushed for aggregate on the road from Acomita to Acoma Pueblo.

Volcanic Rocks

Pyroclastic deposits composed of tuff, ash, lapilli, and bombs, and locally mixed pyroclastics and alluvial gravel occur below and interbedded with the basalt and andesite flows on the flanks of Mount Taylor and on part of Horace Mesa. They range in composition from rhyolitic to basaltic. Volcanic cones occur at several localities on Cebolleta and Horace Mesas. The cones, the source of many of the lava flows, are generally a few tens of feet high but have been considerably eroded so that only massive basalt and coarse fragmental material are left. Late Tertiary or early Quaternary basaltic or andesitic lava flows cap Cebolleta and Horace Mesas and Mesa Negra. Recent basalt flows occur in the valley bottom west of McCartys.

Structure

The Acoma reservation lies within the Acoma Sag, an embayment on the southeastern edge of the San Juan Basin, between the Zuni uplift on the west and the Lucero uplift on the east. The layered rocks are near horizontal with a gentle northwest regional dip. They are slightly deformed locally by small undulations and by numerous faults with small displacements. The Crow Point fault has a displacement of as much as 120 feet in Acoma valley, but diminishes and passes into small folds at the north and south ends. Other faults are similar but have smaller displacements.

MINERAL RESOURCES

General

Mineral resources of the Acoma Reservation have not been studied extensively. The area contains a variety of mineral resources, and may contain undiscovered uranium deposits. Coal occurs within the reservation, but information is sparse. Neither petroleum nor natural gas has been discovered in the area. Sand and gravel, and clay are present, but little development has occurred. Lapidary materials may become important locally. No significant metallic resources are known on the reservation.

Energy Resources

General

Coal is the largest known energy resource on the reservation. Uneconomic uranium resources were discovered at Woods Mesa in 1955, and a radioactive anomaly is known immediately north of the reservation boundary. The possibility of a petroleum and/or natural gas discovery has been rated at 10 percent or less by the Conservation Division of the U. S. Geological Survey.

Coal

Coal occurs in the southernmost part of the reservation and in the five sections of land owned by the tribe in T. 11 N., Rs. 8 and 9 W (Figure 4). The greater resource is probably in the Datil Mountain field to the south, but the area is unexplored and information is sparse. About the only description of the Datil Mountain field available is that of Read, Duffner, Wood, and Zapp (1950) who state:

> "The coal in the Datil Mountain field occurs in Upper Cretaceous strata that are correlated with portions of the Mesaverde Formation in the adjacent San Juan River region. The scanty information available concerning the deposits indicates that the coal is of subbituminous rank over most of the area, though locally it may be of bituminous rank. The beds usually are thin and are rarely reported to be more than 3 feet (1 m) in thickness."
>
> "In general, the area is synclinal, but the geologic structure is complicated as a result of some folding, faulting, and igneous intrusion. Until more detailed studies of the coalbeds are made, estimates of the coal reserves must be classed as inferred."

The same authors estimate the total coal resource in the field to be 1.3 billion short tons (1.2 billion mt). However, only about 15 to 20 percent of the field is within reservation boundaries. Therefore, if the 1.3-billion-ton figure is correct, the resource on the reservation may not exceed 300 million tons (272 million mt). More recent publications on strippable coal reserves of the area--Kottlowski, Beaumont, Shomaker (1971) and staff, U. S. Bureau of Mines (1971)--list no strippable reserves for the Datil Mountain field. Similarly, Matson and White (1975) list no underground minable reserves for the Datil Mountain field. However, it should be mentioned that the Datil Mountain field has been little explored and the resources of the field are not accurately known.

Coal in the five tribally owned sections in T. 11 N., Rs. 8 and 9 W., is within the East Mt. Taylor coalfield. It is in the Crevasse Canyon Formation of the Mesaverde Group, which commonly contains two coal-bearing units: the Dilco, or lower coal member, and the Gibson, or upper coal member. Hunt (1936) reports that coal occurs in all of T. 11 N., R. 8 W., and in T. 11 N., R. 9 W., but does not indicate coal in the sections owned by the Indians. However, he did describe coal underlying Indian land on Horace Mesa and reported that the coal does not exceed 14 inches (35.5 cm) thick. Kottlowski and Parkhill (1971) reported coalbeds 3 ft (1 m), 5 ft (1.5 m), and 7 ft (2.1 m) thick north of the Indian land in T. 11 N., R. 8 W. A 3-ft. coal bed was mined in the 1930's from two mines about 6 miles (9.6 km) north of the Indian land. Most of the coal in the area is probably in the Gibson Coal Member but the Dilco Coal also is present. Without a detailed field examination, it is impossible to determine if reserves are sufficient to sustain a mining operation.

Oil and Gas

Petroleum and natural gas have not been discovered on Acoma lands, although at least two exploratory wells have been drilled. According to the Conservation Division, U. S. Geological Survey, the nearest petroleum production is probably the Elmer L. White Well No. 3 in sec. 13, T. 15 N., R. 10 W., completed in April 1956, and initially yielding 12 barrels of oil per day. It is probably abandoned now.

The sedimentary sequence is thin, less than 5,000 ft (1,525 m), and the outlook for oil and gas discovery is not promising. The Conservation Division of the Geological Survey rates the oil and gas potential of the reservation as poor, chances of discovery being 10 percent or less.

Uranium

No economic uranium deposits have been discovered, and only one occurrence has been found within the Acoma reservation. Important uranium ore bodies do occur, however, east, west, and north of the reservation in the Laguna, Grants, and Ambrosia Lake districts.

The principal host rocks for uranium in the three districts is in the Jackpile sandstone, and the Westwater Canyon Member of the Morrison Formation. The Todilto Limestone contains small economic uranium deposits east of the reservation.

Only one uranium occurrence has been discovered on the reservation (Figure 5). About 1955, Frost Geophysical Co. explored by drilling an area called Woods Mesa in sec. 5, T. 8 N., R. 7 W., and secs. 20, 29, 32, T. 9 N., R. 7 W. Drilling was spaced on 1,000-foot centers. Particulars of the drilling program are not available, but reportedly the drill holes penetrated both the Morrison and Todilto Formations and bottomed in the underlying Zuni Sandstone. Low grade uranium mineralization was encountered in both the Morrison and Todilto Formations, but it was not considered economic in 1955.

Indications of radioactive material are within a few hundred feet of the north boundary of the reservation (Figure 5), where two water wells penetrated the Zuni Sandstone. Tests conducted by the U. S. Geological Survey found anomalous concentrations of helium, a product of uranium disintegration, in the top 10 ft. (3 m) of the Zuni aquifer (Maxwell, 1976, oral commun.) The anomaly does not prove the presence of uranium in economic concentrations, but it does indicate a good target area for exploration.

Nonmetallic Resources

General

Nonmetallic resources on the reservation consist of rock, sand and gravel, clays, and lapidary material. These nonmetallic resources are used to a limited extent. Rock is quarried and used on the reservation; clay is mined for making pottery; and jet, a form of coal, is collected for use by Acoma silversmiths. Only sand and gravel have been produced by outside interests.

Rock Resources

Rock resources, such as sandstone, limestone, and basalt, occur on the reservation in vast quantities. Both red and white sandstone, suitable for building and landscaping, abound.

The Acoma people have not made any attempt to produce or market their rock resources except for use in constructing their own living and tribal quarters. It is likely, however, that only a limited local market exists for such products.

Sand and Gravel

Sand and gravel resources on the reservation are not large. Some sand and gravel pits have operated in the past, but none currently are being developed (Figure 6). Sand and gravel on the reservation can be mined by permit; apparently no lease is necessary. Former production was at the common corner of secs. 23, 26, T. 10 N., R. 8 W., by the State Highway Department, whose permit expired in 1968. The State Highway Department also had a permit, that expired in 1967 on 10 acres (4 ha) in the SW¼NW¼ sec. 25, T. 10 N., R. 8 W., and had permits in sec. 22, and NE¼NE¼ sec. 21, T. 10 N., R. 8 W., which expired upon completion of Interstate Highway 40. The last royalty figures for which records were available indicate that the Indians received 12 cents per ton for their sand and gravel. Most of the gravel has been exhausted; only minor reserves are left, and these are being conserved for Indian use.

Clays

The Acoma people have used local clay for making pottery. This material is being mined from a deposit in secs. 31 and 32, T. 8 N., R. 7 W. (Figure 6). The raw clay is a dark gray and fires light to medium gray, and occurs as a seam 2"-4" thick, that is overlain by 10 or more feet of sandstone. The quantity of clay present on the reservation is unknown.

Lapidary Materials

Lapidary materials, including agate, jet, chalcedony and petrified wood, occur on the reservation, but with the exception of jet, apparently no attempt has been made to market them. Jet, a dense, hard, black form of coal from an area in the Datil Mountain coalfield (Figure 4) is cut and polished, and set in silver jewelry by Acoma silversmiths.

MARKETS

With the exception of coal, mineral products of the reservation probably will be confined to a local market. If a significant coal resource can be found on Acoma land it might be marketed regionally or nationally.

If economic deposits of uranium are discovered the uranium will be marketed nationally because there is no local market.

MINERAL LEASING

Established Federal regulations require royalty and rental fees for mineral leases on Indian reservations, and, a bond must be posted by the lessee for each lease. Regulations pertaining to mineral leasing may be found in the Code of Federal Regulations, 25 CFR and 30 CFR, Requirements for bonds are as follows:

For less than 80 acres (32.4 ha)	$1,000
For 80 acres (32.4 ha) and less than 120 acres(48.6 ha)	$1,500
For 120 acres (48.6 ha) and not more than 160acres (97.2 ha)	$2,000
For each additional 40 acres (16.2 ha), or part thereof, above 160 acres (97.2 ha)	$ 500

The bond for minerals other than oil and gas may be less, provided the Secretary of the Interior, with consent of the tribe, agrees; or a lessee may file a bond of $15,000 for all leases in one State if the total acreage does not exceed 10,240 (4147.2 ha). A lessee may also file a bond of $75,000 for nationwide coverage.

Lessees may acquire more than one lease, but a single lease may not exceed 2,560 acres (1036.8 ha) for minerals other than coal. Ordinarily, coal leases also are limited to 2,560 acres, but upon application, leases can be combined. Leases may be made for any specified term not to exceed 10 years. A diagram of the procedure for obtaining leases and mining permits is shown in Figure 7.

Rentals for minerals are set at $1.00 per acre (.4 ha) and a development expenditure of not less than $10.00 per acre per year.

Unless otherwise authorized by the Commissioner of Indian Affairs, the minimum rates for minerals other than oil and gas shall be as follows:

(a) For substances other than gold, silver, copper, lead, zinc, tungsten, coal asphaltum and allied substances, oil, and gas, the lessee shall pay quarterly or as otherwise provided in the lease, a royalty of not less than 10 percent of the value at the nearest shipping point, of all ores, metals, or minerals marketed.

(b) For gold and silver the lessee shall pay quarterly or as otherwise provided in the lease, a royalty of not less than 10 percent to be computed on the value of bullion as shown by mint returns after deducting forwarding charges to the point of sale; and for copper, lead, zinc, and tungsten, a royalty of not less than 10 percent to be computed on the values of ores and concentrates as shown by

reduction returns after deducting freight charges to the point of sale.

(c) For coal the lessee shall pay quarterly or as otherwise provided in the lease, a royalty of not less than 10 cents per ton of 2,000 pounds (907.2 kg) of mine run, or coal as taken from the mine, including what is commonly called "slack".

In addition to the Federal regulations, the tribe requires that "some" Indians be hired by any firm extracting minerals from reservation lands.

MAP COVERAGE

The reservation area is well covered by various map publications. Topographic coverage is provided by the U. S. Geological Survey topographic quadrangles. The entire area has been mapped on the 7 minute or 1:24,000 scale. Such maps may be purchased from U. S. Geological Survey, Branch of Distribution, Central Region, Box 25286, Denver Federal Center, Denver, Colo. 80225. A list follows of topographic quadrangle maps covering the reservation.

7½-Minute Quadrangles

Acoma Pueblo	Grants SE
Blue Mesa	Laguna Honda
Broom Mountain	Los Pilares
Cebolleta Peak	McCartys
Crow Point	Mecate Meadow
Cubero	Sand Canyon
East Mesa	

Another source of map coverage for the reservation is the U. S. Bureau of Land Management, which has published both land status master title plats and land status quadrangles. Both series of maps can be ordered from the Bureau of Land Management, Records Section, P. O. Box 1449, Santa Fe, N. Mex. An historical index accompanies the master title plats. The quadrangles, master title plats, and historical indexes should be ordered by township and range.

The New Mexico State Highway Department also publishes useful maps of the reservation. Requests should be addressed to the New Mexico State Highway Department, Duplicating Services, P. O. Box 1149, Santa Fe, N. Mex. 87503. The Highway Department has county road maps available. The State Geological Survey in Socorro also is a good source of map information.

Aerial photographic coverage of the reservation may be purchased from both the Geological Survey and the Department of Agriculture. The agencies within the Department of Agriculture from which photos may be obtained are the U. S. Forest Service and the U. S. Soil Conservation Service. Satellite imagery can be obtained from the U. S. Geological Survey, EROS Data Center, Sioux Falls, S. Dak.

RECOMMENDATIONS

Recommendations for further work on the reservation include:

1. A field examination should be made to determine whether economically minable strip and underground coal reserves exist on the reservation.

It is also recommended that an attempt be made to determine whether a market exists in the region for use of the coal.

2. A field examination including drilling is recommended in the Woods Mesa area and inside the reservation near the two water wells that showed anomalous concentrations of helium to determine whether economic concentrations of uranium exist on the reservation.

3. A field examination should be made to identify the quantity and type of clays present on the reservation.

REFERENCES

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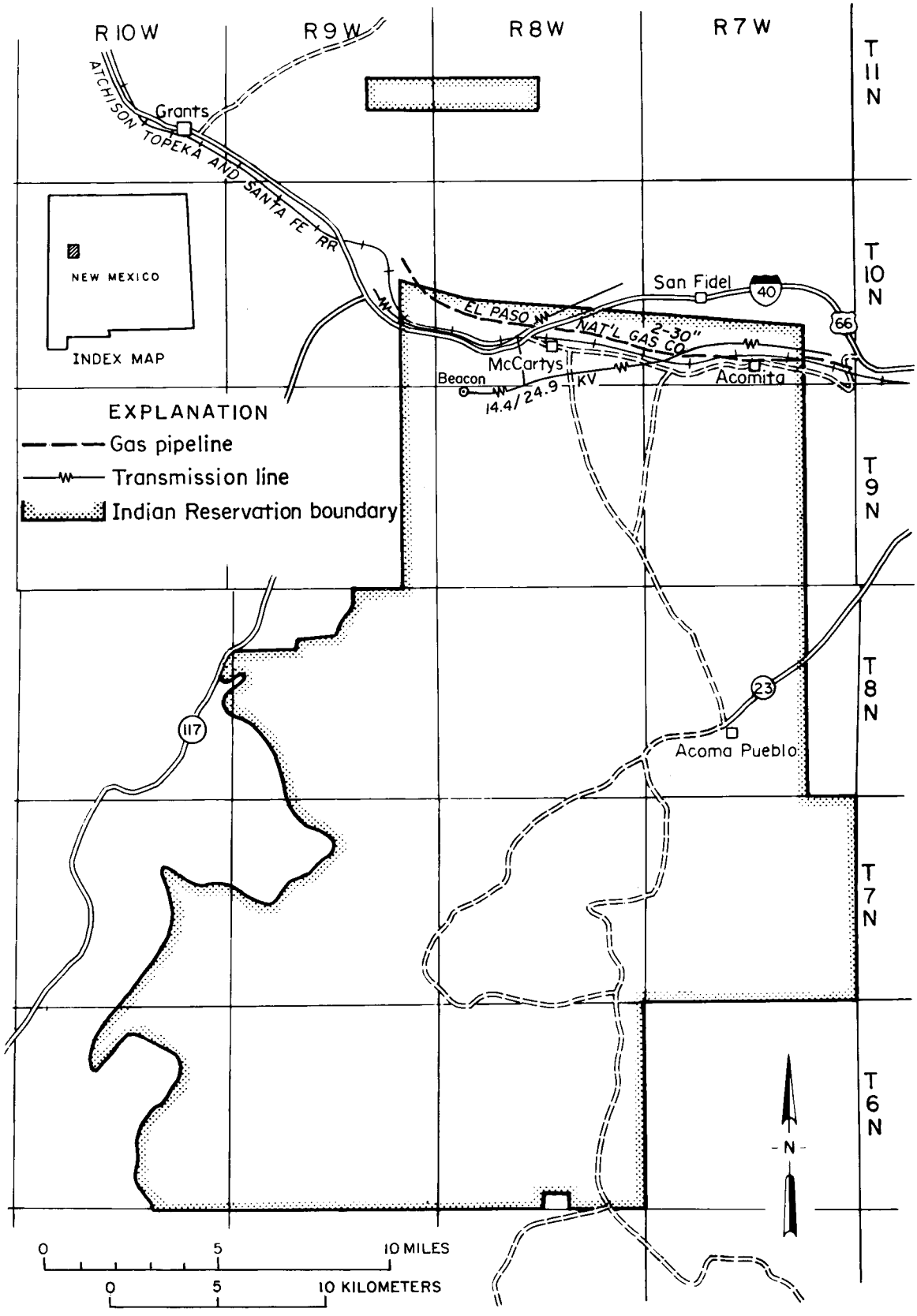

Figure 1. Index map showing infrastructure of Acoma Indian Reservation, New Mexico.

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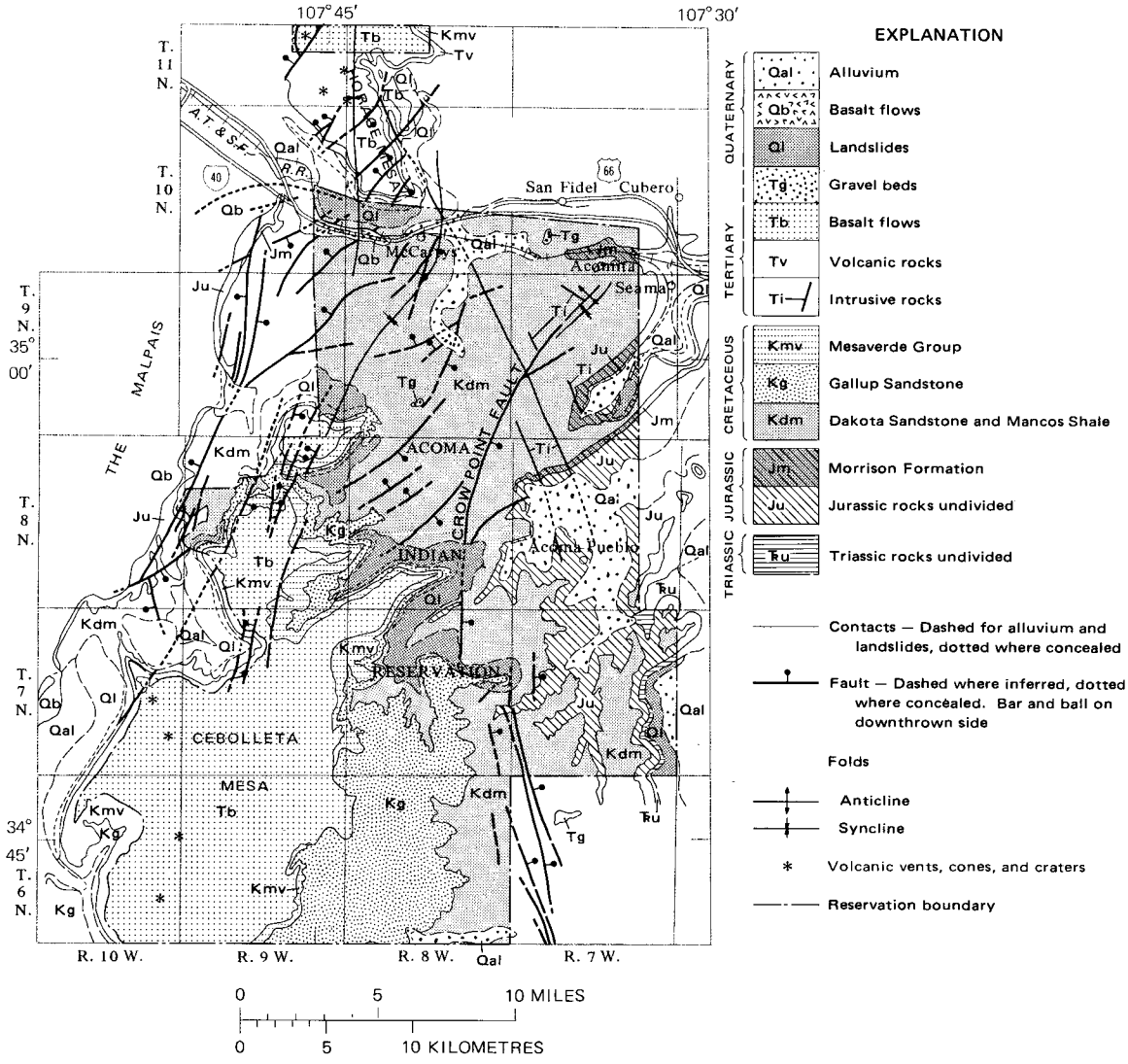

Figure 2. Geologic map of the Acoma Indian Reservation and vicinity (compiled from unpublished maps by C.H. Maxwell, 1976).

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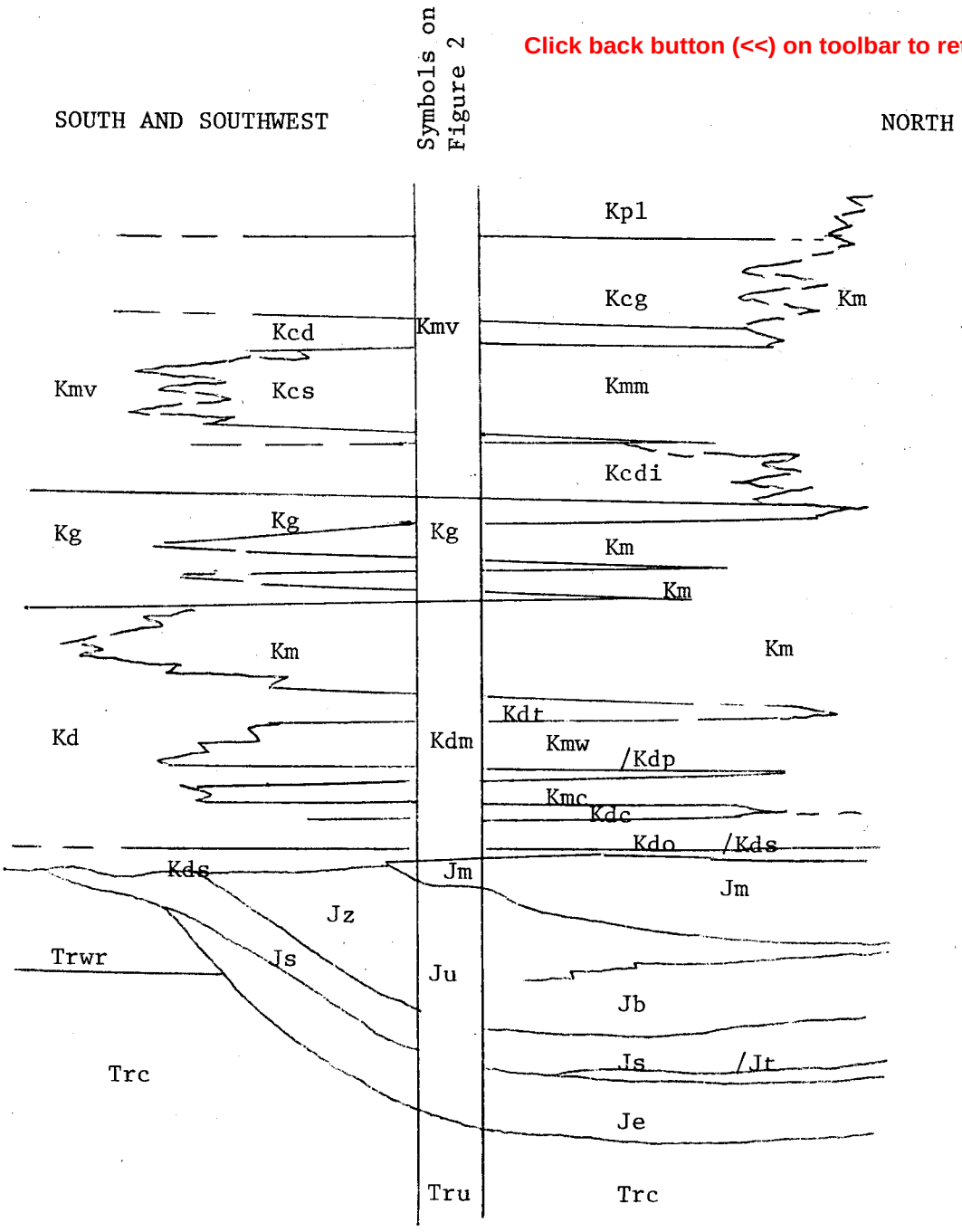

Figure 3. Diagrammatic representation of stratigraphic relationships of rock units on and near the Acoma Reservation.

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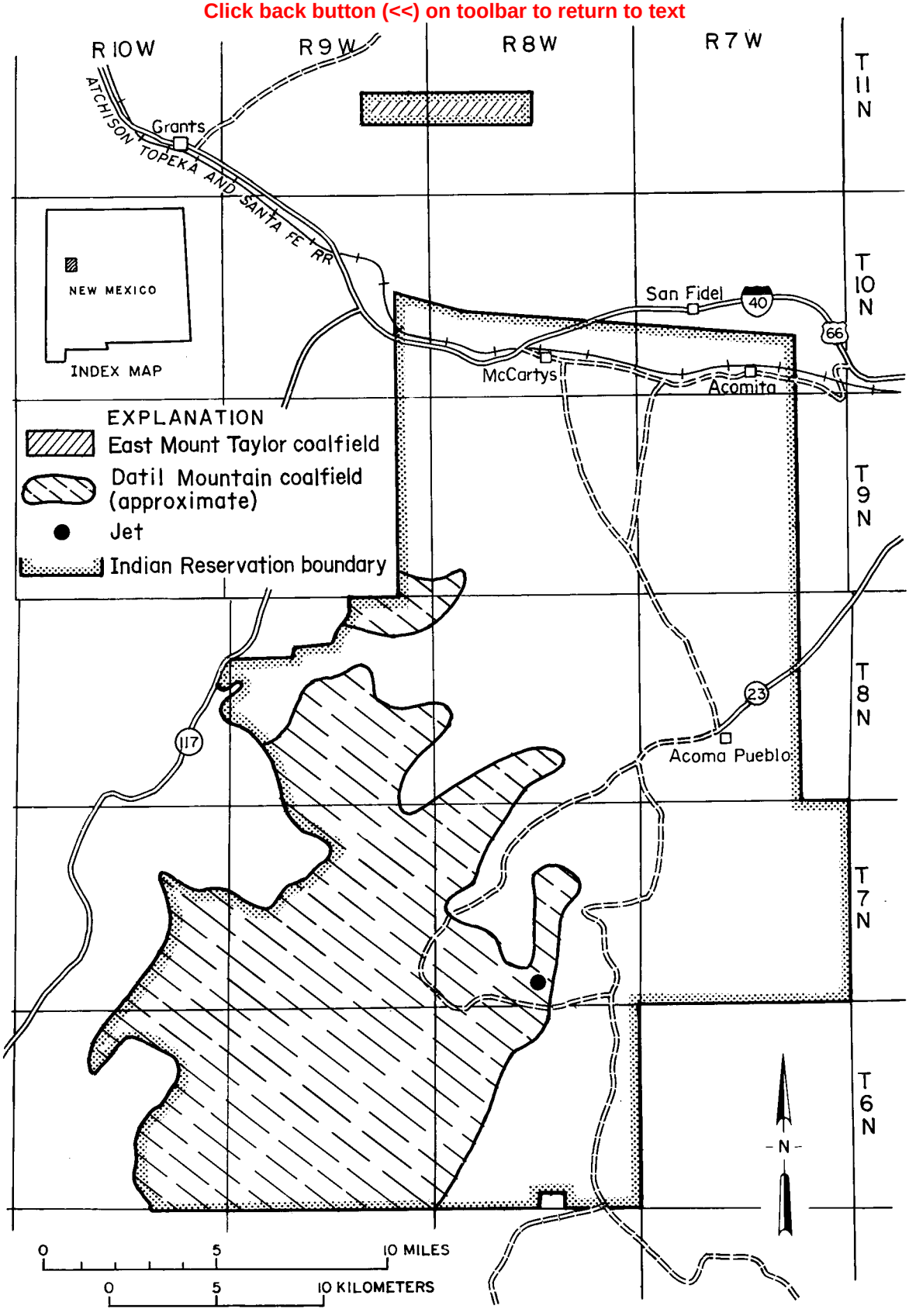

Figure 4. Map showing coal occurrences on the Acoma Indian Reservation.

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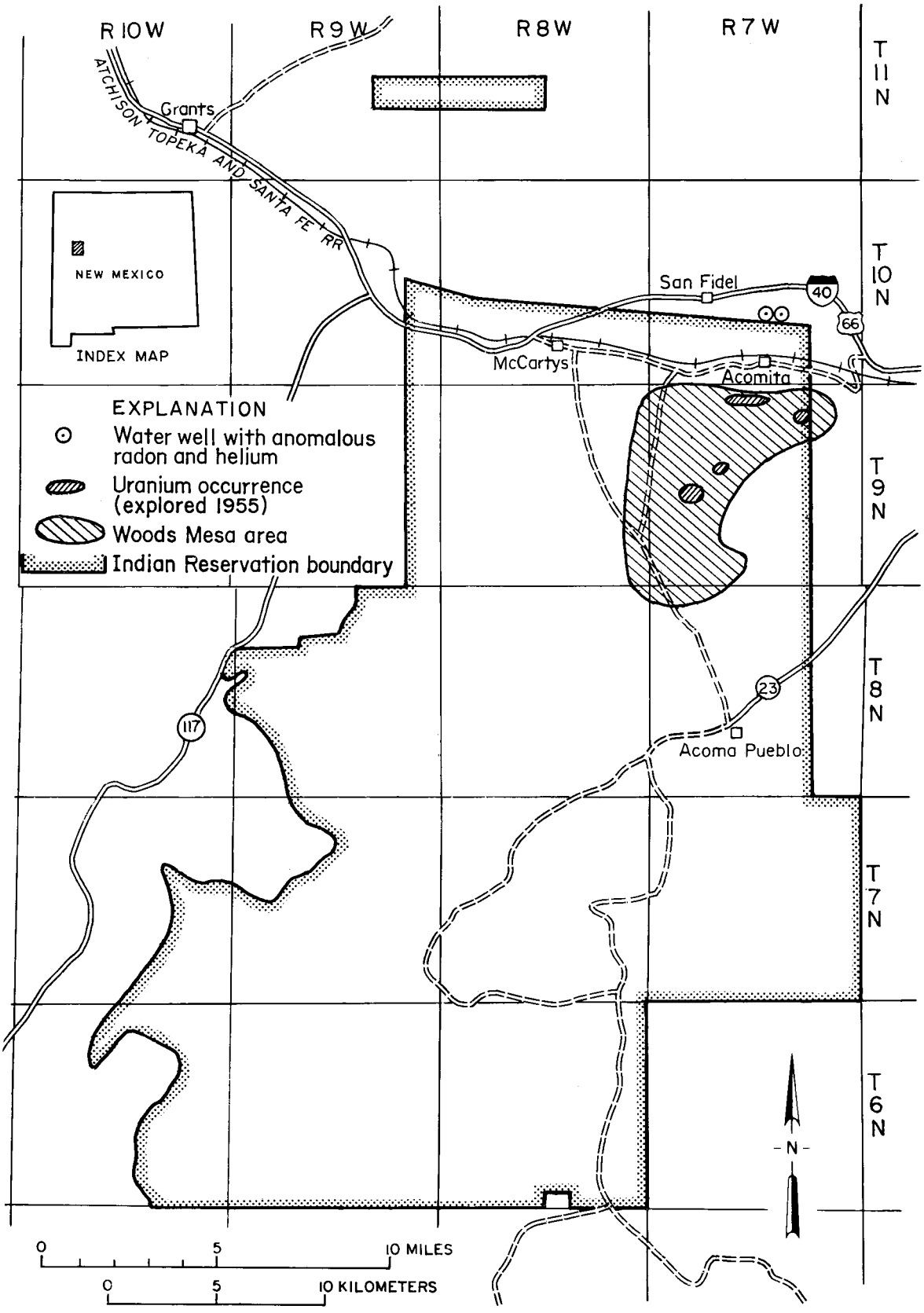

Figure 5. Map showing uranium occurrences on Acoma Indian Reservation.

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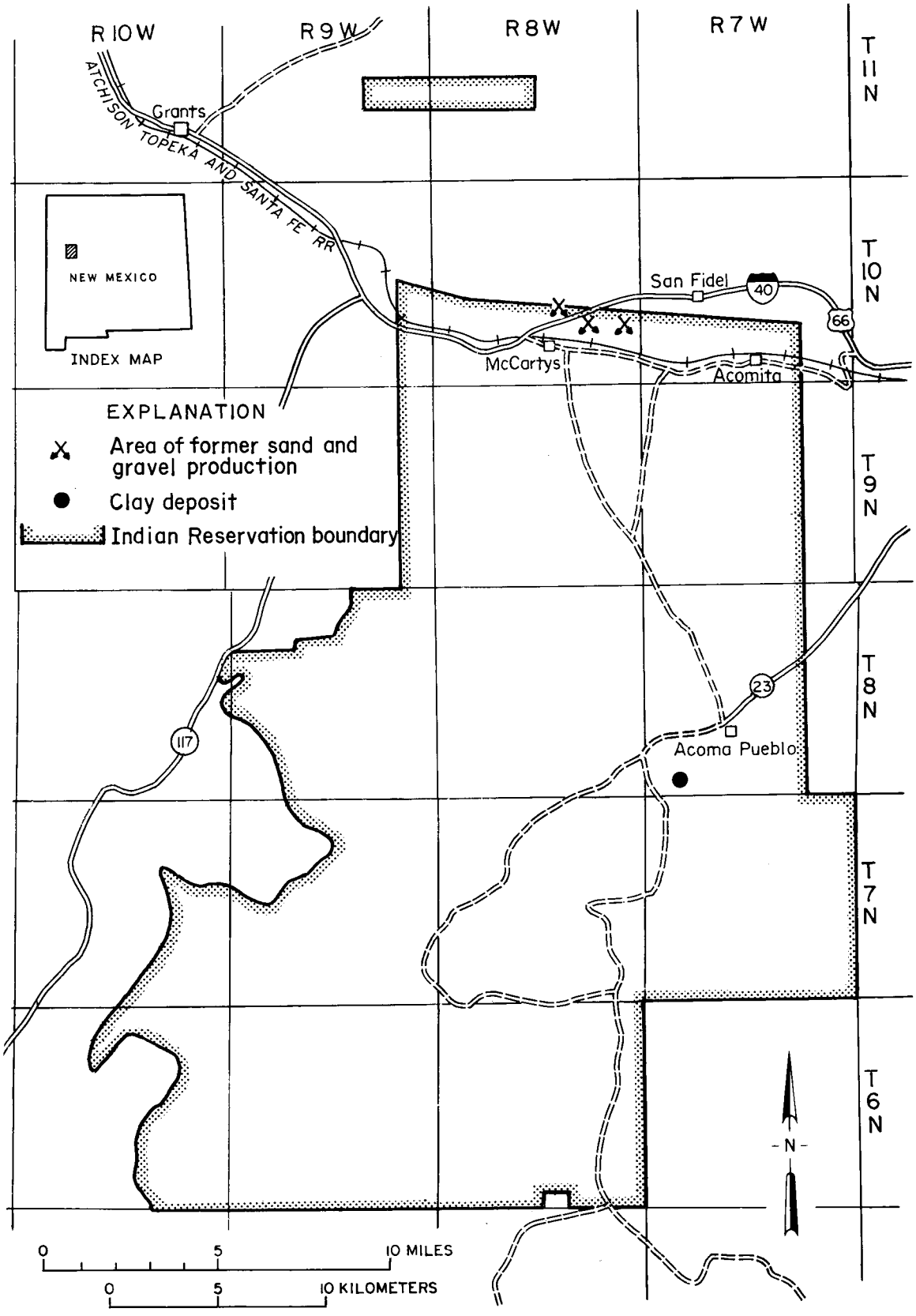

Figure 6. Map showing former sand and gravel producing area and clay occurrence on the Acoma Indian Reservation.

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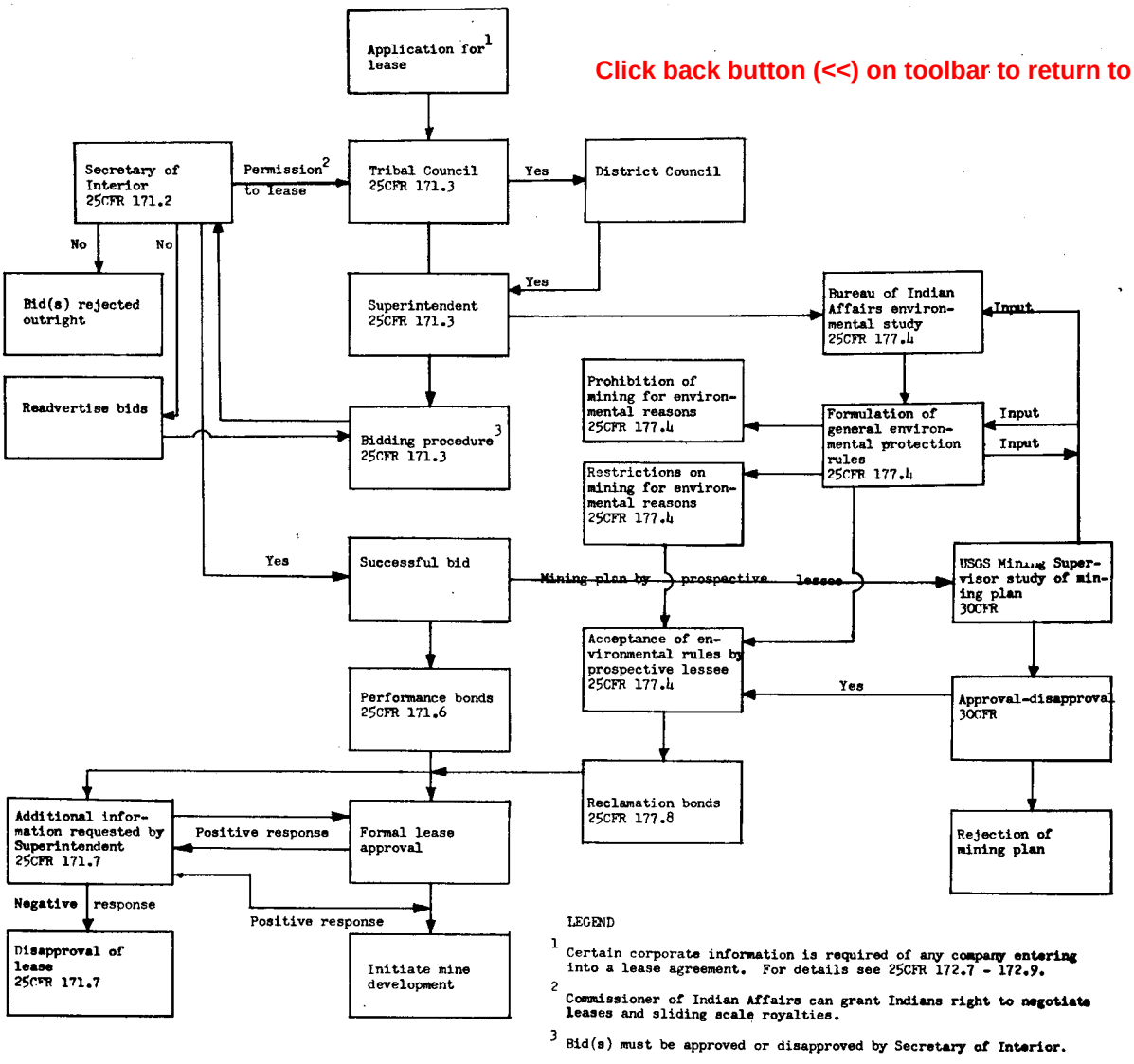

Figure 7. Diagram outlining procedures for obtaining leases and mining permits on the Acoma Indian Reservation.